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Factors affecting the results of the functional dexterity test

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ABSTRACT

Study Design: Cross-sectional study.
Purpose of the Study: The purpose of this study was to identify which demographic and anthropometric features affect performance (time) on the functional dexterity test (FDT).
Methods: One hundred fifty-two healthy subjects between the ages of 20 and 80 years were included in this cross-sectional study. Demographic characteristics (age, gender, height, weight, and dominant hand) and anthropometric (the girths of the first 3 fingers) variables were recorded, and the FDT (net time and total score) was performed.
Results: Hand dexterity (time) was slower in participants aged 60 years (35.7 ± 9.4 seconds) and older compared with those aged 40-59 (27.1 ± 7.2 seconds) years and 20-39 (23.9 ± 4.9 seconds) years ($P <$ .001 for both) in dominant side.
Discussion: There was no significant difference between males (29.1 ± 9 in dominant hands and 30.9 ± 9.5 in nondominant hands) and females (27.9 ± 8.4 in dominant hands and 30.8 ± 8.1 in nondominant hands) in all groups in terms of FDT net time. The factors associated with hand dexterity were age in dominant hands ($R^2 = 0.321$) and age and thickness of the second and third fingers in nondominant hands ($R^2 = 0.282$).
Conclusion: FDT scores increased with increasing age for both dominant and nondominant hands. Finger thickness, especially in nondominant hands, should be taken into account while evaluating FDT scores because of its negative effect on dexterity.
Level of Evidence: Level 2.

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Introduction

Dexterity is appropriate voluntary activity used to manipulate objects during a specific task.[1] Dexterity is among the most important examination methods for the determination of neuromotor function of the hand, which involves integration of motor and sensory functions. Moreover, it is an important indicator for independence in activities of daily living.[1,2]

Dexterity of the hand is affected by many individual factors, such as age, gender, educational level, and hand dominance.[3,4] Dexterity of the hands is better in younger adults as compared with older people and is better in women compared with men.[3-5] In a study comparing gender differences using thin pegs, superior functional skills were found in women compared with men; this has been attributed to women's thinner fingers.[6,7]

The functional dexterity test (FDT) is a fine dexterity measurement method that examines, in particular, the sensory and motor integrations of the first 3 fingers.[8] It consists of a wooden pegboard and 16 pegs. The time-only score represents skill speed, whereas the time plus penalties score represents the quality of performance.[8] The test is a valid method for measuring activity and has been suggested to be used in children with thumb aplasia and people with rheumatologic and musculoskeletal diseases.[9-12] Reliability and normative data have been established in previous studies on American and Italian populations.[8,13]

The role of anthropometric variables in dexterity has not been adequately addressed, particularly with respect to the FDT.[13] The purpose of the present study was to identify the demographic and anthropometric characteristics that affect the results of the FDT.

Conflict of interest: All named authors hereby declare that they have no conflicts of interest to disclose.

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Table 1
Intra- and intergroup comparisons of the FDT scores on the dominant and nondominant hands

Variables	Group 1 (20-39 y) ($n = 55$)	Group 2 (40-59 y) ($n = 51$)	Group 3 (older than 60 y) ($n = 46$)
BMI (kg/m^2) (minimum-maximum)	24.1 ± 3.3 (18.2-33.1)[a]	28.4 ± 5.9 (19-38)	28.4 ± 5.2 (18-40)
Dominant thumb size (mm) (minimum-maximum)	17.3 ± 4.8 (7-25)	19.5 ± 4.6 (11-29)[b]	20.7 ± 4.9 (11-30)[c]
Dominant index finger size (mm) (minimum-maximum)	10.9 ± 3.2 (5-18)	13.4 ± 4.2 (5-22)[b]	14.2 ± 4.2 (7-25)[c]
Dominant third finger size (mm) (minimum-maximum)	11.3 ± 3.3 (5-19)	14.5 ± 3.9 (7-22)[b]	15.3 ± 4.2 (9-27)[c]
Nondominant thumb size (mm) (minimum-maximum)	15.9 ± 4.8 (6-25)	18.5 ± 4.7 (11-29)[b]	19.6 ± 4.7 (10-29)[c]
Nondominant index finger size (mm) (minimum-maximum)	9.8 ± 3.5 (3-18)	12.3 ± 4.1 (5-21)[b]	13.7 ± 3.9 (7-23)[c]
Nondominant third finger size (mm) (minimum-maximum)	10.3 ± 3.3 (5-20)	13.3 ± 3.8 (6-20)[b]	14.5 ± 4.2 (8-25)[c]
Dominant hand net time (s) (minimum-maximum)	23.9 ± 4.9 (14.8-39.0)	27.1 ± 7.2 (16.7-55.9)[e]	35.7 ± 9.4 (21.5-64.4)[d]
Nondominant hand net time (s) (minimum-maximum)	27.1 ± 6 (16.4-39.3)	28.8 ± 7.9 (18.7-60.7)	37.8 ± 8.8 (21.5-75.7)[d]
Dominant hand total score (minimum-maximum)	27.6 ± 9.8 (14.8-66.1)	33.2 ± 14 (16.7-80.7)[e]	46.0 ± 15 (21.5-57.2)[d]
Nondominant hand total score (minimum-maximum)	33.3 ± 13.2 (16.4-76.5)	38.3 ± 15.4 (19.5-90.8)	50.2 ± 15.5 (21.5-88.9)[d]

FDT = functional dexterity test; BMI = body mass index.
[a] $P < .001$ for patients aged 20-39 years compared with patients aged 40-59 years and older than 60 years.
[b] $P < .001$ for patients aged 40-59 years compared with patients aged 20-39 years.
[c] $P < .001$ for patients aged 60 years and older compared with patients aged 20-39 years.
[d] $P < .001$ for patients aged 60 years and older compared with patients aged 20-39 and 40-59 years.
[e] $P < .05$ for patients aged 40-59 years compared with patients aged 20-39 years.

Methods

This cross-sectional study was approved by the local ethics committee. A total of 152 healthy subjects between the ages of 20 and 80 years who were eligible for the study were informed, and all agreed to participate in the study. After that, all subjects signed the written informed consent.

The exclusion criteria were as follows: (1) objective or subjective motor and/or sensorial diseases or symptoms in the upper limbs, (2) the presence of orthopedic deformity of the upper limbs, (3) the presence of peripheral neuropathy or diseases predisposing to peripheral neuropathy (including diabetes mellitus, hypothyroidism, and renal failure), (4) inflammatory rheumatic disease, carpal tunnel syndrome, tendinopathy of the hand/wrist, arthrosis of the thumb, hand osteoarthritis, decreased range of motion due to fractures or tendon injuries, and complex regional pain syndrome, (5) acromegaly, and (6) participants unable to speak Turkish, having cognitive impairment, or using sedative drugs.

Demographic characteristics (gender, height, weight, and dominant hand), as well as the girths of the first 3 fingers, were recorded for all participants. For this measurement, a paper strip of 0.5 × 20 cm was placed circumferentially at the level of the lunula to measure the thickness of the tips of the first 3 fingers.[14]

The FDT was performed as described by Aaron and Jansen.[8] The examiner explained the test to the participants by turning 4 wooden pegs and asked each participant to try the test using the dominant hand and turning the wooden pegs as described. After the practice, the test was started. The test pegboard was placed 10 cm from the edge of the table, and the participant was seated on a comfortable chair. Participants were asked to turn each peg over and then replace it onto its slot by grasping it with the first 3 fingers without dropping the pegs as fast as they could. In addition to, the participants were warned not to touch pegboard while replacing the pegs. The test started from the opposite upper edge of the pegboard according to the hand being tested. After inverting 4 pegs in a row, the subject was asked to turn over the next 4 pegs in the opposite direction. In this way, the turning action for all pegs in the pegboard was completed in a zigzag pattern. The test was performed for each hand twice, starting with the dominant hand. The observer recorded the turning time for all pegs, errors, and unusual motion patterns for both hands of each participant.

Two scores were obtained from this test. The first score was the net time (in seconds), calculated as the processing time without adding the error time. The second score was the total score obtained by summing the processing time and error time. If the participant's hand went into supination after grasping the peg into her or his hand, or had help from the pegboard during the inversion movement, 5 seconds of error time was added to the total score. If the participant dropped the peg, the timer was stopped, and 10 seconds of error score was added to the total score. Then, the peg was put into its place in the pegboard, and the test was continued with the same peg and the timer restarted.

Cutoff value of the finger thickness that affects the dexterity in the whole group ($n = 152$) was calculated. The article by Aaron and Jansen[8] was used as a reference for establishing dexterity grading. In this article, the authors described the functional levels in 4 grades (functional, moderately functional, minimally functional, and nonfunctional), according to the mean and range of scores, in seconds, without penalty time (net time), for the FDT. In the present study, the participants were divided into 2 groups. Group 1 consisted of 109 participants with a net time under 33.99 seconds (functional and moderately functional), whereas group 2 consisted of 43 participants with a net time of 34 seconds and above. Cutoff values of index and third fingers were found by using the calculation of sensitivity and specificity. This value and greater values of finger girth were defined as the value worsening the hand function.

Statistical analysis was performed using the SPSS 17.0 software package (SPSS Inc, Chicago, IL). Descriptive statistics and frequency analysis were used to analyze the demographic characteristics. Qualitative data were analyzed using the chi-square test. The paired t test was used for the intragroup analysis. The 1-way analysis of variance test was used for intergroup comparisons, using the

Table 2
Comparisons of intergroup FDT scores

Variables	Net time		P	Total score		P
	Dominant	Nondominant		Dominant	Nondominant	
Group 1	23.9 ± 4.9	27.1 ± 6.03	.001	27.6 ± 9.8	33.3 ± 13.2	.001
Group 2	27.1 ± 7.2	28.8 ± 7.9	.001	33.2 ± 14	38.3 ± 15.4	.001
Group 3	35.7 ± 9.4	37.8 ± 8.8	.001	46.0 ± 15.0	50.2 ± 15.5	.001

FDT = functional dexterity test.

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